# ON THE COUNTERMEASURE AGAINST DISEASE IN MARINE FISHES AT THE SUMA AQUARIUM OF KOBE CITY

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# ON THE COUNTERMEASURE AGAINST DISEASE IN MARINE FISHES AT THE SUMA AQUARIUM OF KOBE CITY

By

KAZUTSUGU HIRAYAMA and MOTOAKI SHIOMI
平山和次・塩見元晶
*Suma Aquarium of Kobe City, Hyogo Prefecture, Japan*

The Suma Aquarium of Kobe City was opened to the public in May 1957.

Looking upon the condition for raising marine fishes in the Aquarium to date, it seems that the history is a war against disease in marine fishes[1)2)3)]. Especially in the opening year, a white spot disease had spread to all of the marine fishes, except Apodes and Elasmobranchii. So in the summer, it was repeated that nearly all of the fishes in the exhibition-tanks were dead and the tanks became empty.

The cause of the disease spreading to all of the fishes seemed to be the reception of so many fishes in the circulatory system before the ability of clarifing the water in the filter beds had not been brought enough, the defect of the filter construction, and the inexperience on raising the fish. The filter beds were increased from 14.2m². to 34.8m²., and the water cooling apparatus was built in the next year (1958). Many methods for the extermination of the white spot disease had been carried out, steadily and strongly. As shown in the table 1, the raising of marine fish in the Suma Aquarium became better and better. As the result, in 1962, the marine fishes were less damaged with this disease, and few fishes attacked with the disease took a turn for the worse.

Table 1
The number of species of marine fishes in the Suma Aquarium in late March

| Year | '58 | '59 | '60 | '61 | '62 |
|---|---|---|---|---|---|
| Number of species | 53 | 87 | 90 | 112 | 139 |

## THE WHITE SPOT DISEASE IN THE MARINE FISHES

Dr. Sikama had already reported on the previous knowledges of this disease in "AQUICULTURE" Vol. 10, No. 1 and 2, under the title of "Studies on the spot-disease in marine fishes"[4)].

According this report:

The white spot disease is one of the most prevalent diseases of fishes in the aquarium which is characterized by the appearance of small white spots on the fins, the skin and the gills, which indicate the parasite. The fish with serious illness are accelated to secrete mucus, and peel off the skin, become weakened and suffocated to death at last, after three to ten days if violent.

The parasite is a Ciliata (Protozoan) named *Ichthyophthirius marinus* by Dr. Sikama which is similar to the parasite (*Ichthyophthirius multifiliis*) of the fresh water white spot disease. But having four nuclei, the former is distinguished from the latter. It penetrates the mucous coat and upper layer of the epidermis, but does not enter into the body. It grows on the fish's skin to about 450$\mu$ in the largest diameter. It leaves the fish when the host fish becomes dead. The mature parasite, having left its host, sinks to the bottom of the water, where it turns into a so-called "cyst". In the cyst the parasite undergoes division into numerous youngsters. For sometime they will be swimming freely through the water in search of a new host. The speed of their reproductive process depends on the water temperature.

## THE PREVIOUS WAY OF THE TREATMENT ON THE WHITE SPOT DISEASE AT THE SUMA AQUARIUM

The ways of the treatment of the white spot disease which have been tried to this time at the Suma Aquarium, are as follow.

1) Applying medicine to the skin of the sick fish (1957–1958).

Taking the sick fish out of the water, and coating the skin with the medicine (c. f. Mercurochrome) was tried. But it brought no effect.

2) Cleaning and disinfecting the tank (June, 1958).

After shutting the entrance door, during the night the fishes were taken out of the tanks, then they were cleaned with the fresh water, and disinfected with the soapless soap.[5] This work was carried out two nights. But after three days, the disease began to invade again the fish, so this method had no effect.

3) Dissolving the medicine in the circulatory water (June, 1958).

Quininae Sulphite (1390 gr.) was dissolved in the circulatory water (120 m$^3$.) during two days. For four days after dissolving, the sick fishes had not become worse and the disease had not invaded the healthy fishes, but after one week the effect of the medicine showed no recovery. All Echinoderms were killed by it. Neverthless Octopus survived in this condition, but became weakened and fell into tonic convulsions. However they regained their health after four days. This suggested that the medicine was destroyed after four days, and therefore had no further effect.

4) Stopping the water flowing into the tank and dissolving the medicine in the water of the tank. (1958– )



The methods 1, 2, 3, all had no effect, so extermination of the white spot disease in a short time was given up, and another method was tried, as follow.

At night, the medicine was dissolved in the airated water in the tank with the sick fishes, and the supply of the filtered water was stopped. Next morning, the filtered water was poured into the tank again, so the condition was restored. This method was repeated every night until the fishes were cured of the disease. In 1958, the Rabbit Fish (*Siganus fuscescens*) and Rainbow Fish (*Thalassoma cupido*) with the slight illness were recovered completely by this method. Now this method modified, has been mainly used.

## OTHER THAN THE WHITE SPOT DISEASE

Before 1960, the observation was insufficient to discover the other disease. Only the parasite *Epibdella* sp. on the Yellow Tail (*Seriola quinqueradiata*), "ISHIDAI" (*Oplegnathus fasciatus*) and the others, was observed in 1957.

In 1960, the abnormal sign of ulceration on the skin of the Red Sea Bream (*Chrysophrys major*) was developed with the sign of the white spot disease, there were 32 fishes on October 1. After then the deaths of the fishes attacked with this unknown disease, continued. So on March 3, only 18 were alive, but from then the Tetracycline (1 cupsule contains 250 mgr.) which was mixed in their baits, were given, once a day at the rate of 1/3 to 1/6 cuspule par one (average total length was about 40 cm.). Therefore they were getting better, and they seemed to be completely restored to health in late May.

On the File Fish (*Navodon modestus*) and the others, the sign of ulcerations, accompanied by the white spot disease, was observed. From 1960, when the white spot disease attacked the fishes, Tetracycline was dissolved in the water with Quinine, for fear of the combined disease.

In June 1962, the sign which was similar to that of a Fungi-disease of the fresh water fishes, was observed on the Blue Parrot Fish (*Callyodon* sp.), Unicorn Fish (*Naso unicornis*) and Squirrel Fish (*Holocentris ittodai*), independently of the white spot disease. The supply of the water poured into the tank was stopped during two to three hours a day, and the water was airated. Then three or four cupsules of Tetracycline were dissolved in the water 1 m$^3$. This method was carried out for four days, and the Blue Parrot Fish and Unicorn Fish were cured. The Squirrel Fish were cured too, after 10 days by dissolving Methylen-blue in the water in the same way.

## THE WAYS OF COUNTERMEASURE TO EXTERMINATION OF THE DISEASE IN MARINE FISHES

The record of raising the marine fishes in the Suma Aquarium during five years from the opening, was mentioned above. The points which seem important to the

extermination of the disease, according to the previous experiences, and the way of medical treatment, are described as follow.

A PREVENTION

1 WATER CONTROL[6]

One of the most important points in the water control in the closed-system aquarium seems to keep the water quality as constant as possible, and to avoid a sudden change of the water quality, though of course, the conditions to the fishes are important.

The standards of the water quality in the Suma Aquarium are as follow.

a) Water temperature

Except the water in the tanks where the special fishes are kept, the water is heated above 20°C. in the winter and cooled to about 23°C. in the summer. The variation of the temperature in a day is kept within 2°C.

b) pH

CaO 1 to 2 kg. a day are dissolved in the circulatory water 120 $m^3$. almost every day, so as to keep the pH above 7.3.

c) Chlorinity

The water evaporates by heating in the winter and the Chlorinity in the water becomes above 19.00‰. The aquarium water is made to keep the Chlorinity above 18.00‰ throughout the year, so that the new water which is added to the circulatory water, is pumped up from the open sea so far as possible where the water has high Chlorinity. When the density of the water is low, crude salt is added.

d) Dissolved oxygen[7]

From 1960 the aquarium water in the exhibition-tanks was airated to stir up the bottom water, and to prevent the stagnation in any parts of the tank.

e) The other points

When it is necessary to add new water to the circulatory system, the water must be poured into, little by little, so as not to change the water quality largely at a time. The operations on four filter beds are carried periodically one after the other at regular intervals so as to keep the clarifing ability in the filters, constant.

2 THE ISOLATION FROM THE PARASITES

a) Isolation by the filter beds[8]

The parasite of the white spot disease seems not to penetrate through the filter sands within 1 mm. in diameter.[9] So in the Suma Aquarium the sands within 1 mm. in diameter are used in the filter beds, and the unfiltered water is prevented to flow into the fish-tanks.

b) Disinfection of the raising tools

The tools, hand-nets and buckets, are soaked in the fresh water to kill the parasites, after and before use.

c) Exclusion of the fishes from the raising-tanks which are very easily attacked by the disease



The fishes which are easily attacked by the disease, whether they are attractive to the visitors or not, are excluded from the raising-tanks, they are the Box Puffer (*Ostracion immaculatum*), Japanese Parrot Fish (*Leptoscarus japonicus*) and "SETODAI" (*Hapalogenys mucronnatus*).

3 HYGIENE

a) The new fishes transfered into the aquarium from the sea, are tired and weakened by the exfoliation of the mucus and the external wounds during the transport. Therefore after resting enough to recover in the sanitary tanks in the independent circulatory system, the fishes make their first appearance in the exhibition-tanks. Many of the fishes are added, little by little, to the tank separately at intervals. The new exhibited fish seem to be easily attacked by the disease. For prevention of the disease, the fish are placed in the water for several days with dissolved medicine, according to the method mentioned.

b) Cleaning the tank

It is necessary to dispose of the sick fishes as soon as possible and to clean the tanks completely with fresh water too kill the cyst.

B MEDICAL TREATMENT

It is important in medical treatment that the sick fish should be treated at the time of slight attack. Good results by the medicine used are when only one or two white spots are observed on the skin of a fish in the tank. The treatment should be done in the free swimming stage of the parasite, otherwise it is difficult to kill the parasite. So it is done at night. According to Dr. Fujita's report[10] the parasite of the fresh water white spot disease in the cyst stage undergoes division more actively at night.

The method of medical treatment after 1960, took about three to four hours less than before, so as to keep the water from the larger and the worse change in quality. The treatment is done twice a day for some fish[11]. For the white spot disease, Quininae Hydrochloridum 40 gr. to 60 gr. par 1 $m^3$ are dissolved in the water.

As the organic medicine is distroyed in the filter beds, the direct influence of accumulation of the medicine on the fish is not observed. Table 2 shows that the fish cured increase year by year.

The reasons for adopting this method are as follow.

Table 2
Results of the treatment in the Suma Aquarium

| Year | Month | Name of fish | Result |
|---|---|---|---|
| '60 | June | *Holocentrus spinosissimus* "ITTODAI" | − |
| | June | *Myripristis murdajan* "AKAMATSUKASA" | + |
| | July | *Hapalogenys mucronatus* "SETODAI" | − |
| | July | *Pterois volitans* "HANAMINOKASAGO" | + |
| | July | *Lutjanus rivulatus* "FUEDAI" | − |
| | July | *Leptoscarus japonicus* "BUDAI" | − |
| | July | *Siganus fuscescens* "AIGO" | − |
| | July | *Chaetodon collaris* "CHOCHOUO" | − |
| | Aug. | *Stephanolepis cirrhifer* "KAWAHAGI" | − |
| | Aug. | *Pterois volitans* "HANAMINOKASAGO" | − |
| | Aug. | *Amphiprion xanthurus* "KAMANOMI" | − |
| | Aug. | *Lutjanus russelli* "KUROHOSHIFUEDAI" | + |
| | Sep. | *Pterois volitans* "HANAMINOKASAGO" | + |
| | Oct. | *Pterois volitans* "HANAMINOKASAGO" | − |
| | Sep.-Jan. ('61) | *Amphiprion xanthurus* "KUMANOMI" | * |
| | Sep.-Oct. | *Lethrinus haematopterus* "FUEFUKIDAI" | +〜− |
| | Sep.-Oct. | *Lutjanus russelli* "KUROHOSHIFUEDAI" | − |
| | Sep.-Nov. | *Cephalopholis formosanus* "YUKATAHATA" | * |
| | Sep.-Nov. | *Myripristis murdjan* "AKAMATSUKASA" | − |
| | Nov.-Jan. ('61) | *Lethrinus haematopterus* "FUEFUKIDAI" | * |
| | Nov.-Dec. | *Navodon modestus* "UMAZURAHAGI" | − |
| | Nov.-Dec. | *Monocentris japonicus* "MATSUKASAUO" | − |
| '61 | Feb.-Mar. | *Diploprion bifasciatus* "KIHASSOKU" | * |
| | Feb.-Mar. | *Plectorhnchus cinctus* "KOSHODAI" | − |
| | Apr.-May | *Goniistius zonatus* "TAKANOHADAI" | − |
| | Apr. | *Lethrinus haematopterus* "FUEFUKIDAI" | − |
| | Apr. | *Diproprion bifasciatus* "KIHASSOKU" | − |
| | July | *Amphiprion xanthurus* "KUMANOMI" | + |
| | July | *Goniistius zonatus* "TAKANOHADAI" | − |
| | Aug. | *Chromis notatus* "SUZUMEDAI" | − |
| | Aug. | *Balistes capistratus* "MEGANEHAGI" | + |
| | Sep. | *Acanthurus bariene* "KANRANHAGI" | − |
| | Oct. | *Apogen doedeini* "OOSUJIISHIMOCHI" | + |
| | Oct. | *Holocentris spinosissimus* "ITTODAI" | + |
| | Nov. | *Apogen doedeini* "OOSUJIISHIMOCHI" | − |
| | Nov. | *Siganus fuscescens* "AIGO" | + |
| | Nov. | *Holocentus spinosissimus* "ITTODAI" | * |
| | Dec.-Jan. ('62) | *Lethrinus haematotopterus* "FUEFUKIDAI" | + |
| | Dec.-Jan. ('62) | *Diploprion bifasciatus* "KIHASSOKU" | + |
| '62 | Mar. | *Coerodon azurio* "IRA" | + |
| | Apr. | *Gymnocranium griseus* "MEICHIDAI" | + |
| | June | *Balistapus aculeatus* "MURASAMEMONGARA" | + |

\+ ..... cured
* ..... not cured but disease not progressed
— ..... not cured and disease progressed

1) Taking and treating the fish out of the water injure them by peeling off the mucus, which makes them easy for the disease to attack them.

2) As the water quality may become bad, it is not suitable for the water suply into the tank to be stopped for a long time.

Thus, the specific medicine for the white spot disease has never been discovered, so it is impossible to exterminate it at a time.

In conclusion, the constant circumstance, no touch of the fish out of the water,



the discovery of the sick sign in early stage and the effective application of the medicine are the keys for the treatment of the disease.

## CONSIDERATION

The method used at the Suma Aquarium to exterminate the white spot disease suggests that the effect results in the disease being reduced, year by year. In 1962, the sign of the disease was observed only on few fishes. Such treatment of the white spot disease may be applied to other diseases as described above.

Concerning the marine white spot disease, Dr. Sikama and others have studied the life history of its parasite. However its treatment in connection with the conditions in the aquarium, has been scarecely known.

Though it is important to study the parasites of the diseases, it is necessary to repeat the trial and error to get the way of the treatment based on many practical experiences and scientific already-known facts.

The method of the trial and error needs medicine so much that a lot of the costs are spent through the year (Table 3).

Table 3
The amount of medicine used for treatment in the Suma Aquarium

| Year \ Month | Jan.-Mar. | Apr.-June | July-Sep. | Oct.-Dec. |
|---|---|---|---|---|
| '59 | − | 7210 gr. | 8620 gr. | 4980 gr. |
| '60 | 2230 gr. | 3116 gr. | 5938 gr. | 4215 gr. (195 cups.) |
| '61 | 2120 gr. (299 cups.) | 1662 gr. (173 cups.) | 1180 gr. (192 cups.) | 4500 gr. (236 cups.) |
| '62 | 1730 gr. (141 cups.) | 5110 gr. (65 cups.) | | |

Top columns are the amount of Quininae Hydrochloridum.
The number of Tetracycline cupsules are in parentheses.

But it will bring economy of the expenses of purchasing the new fish, and substanciality in the exhibition tanks. And the Suma Aquarium seems to be a case in point.

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